February 19, 2010

To

Lisa Dyer
Project Manager
Public Works and Government Services Canada (PWGSC)
Greenstone Building
Suite 420, 4th Floor, 5101-50th Ave
P.O. Box 518
Yellowknife, NT
X1A 2N4

Re: Health Canada Review of the Supporting Document N1 Tier 2 Risk Assessment, Giant Mine Remediation Plan (SENES, 2006) (The Report)

Dear Ms. Dyer:

Thank you very much for the opportunity to review and comment on the above mentioned report in support of the Giant Mine Remediation Plan. Health Canada Alberta region (HC-AB) recognizes the complexity associated with the historical land uses of the Giant Mine site ("the site") area and thanks PWGSC for coordinating the review process of this remediation project under Federal Contaminated Sites Action Plan (FCSAP) program. HC-AB understands that the Giant Mine Remediation project is in the Environmental Assessment (EA) stage. Please note, under FCSAP program, HC-AB Contaminated Sites Division provides the following comments based on our review of the above report.

General Comments:

1. On June 06, 2005, Health Canada forwarded comments to INAC based on the review of the December 2004 version of the Tier II Risk Assessment Report where five key issues were identified: (i) Toxicity Reference Endpoints; (ii) Receptor Characteristics ;(iii) Bioaccessibility of Arsenic in Soils;(iv) Risk Characterization and, (v) Conclusions.

2. Please note, an overall update of the risk assessment report may be necessary based on the additional environmental and site specific chemical datasets (if available since 2005-2006) to effectively evaluate and assess site specific exposure scenarios, and to modify and characterize human health risks (if applicable) and to further utilize updated results of sensitivity analysis during the discussions and scoping of the future risk management plans, overall remedial decisions and future sensitive land use discussion phases of the project. This may lead to further reduction of the overall uncertainties inherent in any human health risk analysis (assessment, management and communication) projects.

Specific Comments:

1. Updated Arsenic Toxicology: In 2005, Health Canada was providing guidance to custodians to use 2.8 $(mg/kg\text{-}d)^{-1}$ as an appropriate cancer slope factor (CSF) based on skin cancer. Currently, Health Canada recommends 1.8 $(mg/kg\text{-}d)^{-1}$ as a CSF based on internal cancers of multiple organs. Furthermore, based on the site specific exposure analysis and future proposed land uses of various areas of the site, it would be prudent to have a conservative approach in using acceptable cancer slope factors to more accurately reflect emerging information related to Arsenic toxicology and

potential for increased susceptibility from early-life exposure to carcinogens. If further updates are available in the future, HC-AB will share additional information to custodians.

2(i) Sensitivity Analysis: HC-AB understands that the custodian and the consultant reviewed Health Canada's comments and addressed several issues related to Toxicology, Receptor Characteristics, and Bioaccessibility by conducting sensitivity analysis for various input parameters in the risk assessment calculations. However, please clarify whether the sensitivity analysis that was carried out in the report for sensitive receptors (e.g., toddlers) were incorporated in the final risk characterization and conclusions of the report. It appears that the final calculations and summary conclusions were based on adult and child and a composite receptor risk estimates.

For example, on **page 6-42**, the report emphasized that for Giant Mine town site, "*the toddler was anticipated to experience higher exposure than either the adult or child receptors, with a mean arsenic exposure of 2.7 x 10-3 mg/(kg d) and a 95th percentile exposure of 4.3 x 10-3 mg/(kg d). The toddler experiences higher exposure than the adult and child due to its higher intake rate to body weight ratio. In other words, the toddler consumes more food for its size than do the adult or child. The main pathway of exposure is market foods which accounts for 64% of the total intake. Soil accounts for 5% of the total intake. It is not known whether toddlers are present currently at the Town site or will be in the future; however, their exposures would be the highest at this location*" Please note, similar explanations for toddlers are provided for other areas around the site as well. Further, Sensitivity analyses for Bioaccessibility factors (17% and 73%) were conducted by taking adult and child receptors into consideration. The results of the sensitivity analysis for arsenic intake were found to be marginally increased when 73% was used and compared against 17%. HC-AB is not clear whether toddler and other sensitive receptors were taken into consideration for these analyses. Please clarify.

(ii) Background Cancer Risk and Incremental Cancer Risks Comparison: In **Section 6.3.7**, the background cancer risks in Canada to overall cancer risks in NWT population were compared. The report states that, "*the predicted cancer risks are below the lifetime incidence cancer rate of 3 in 10 for the Northwest Territories population (Canadian Cancer Statistics 2003) as well as being below the risks of developing lung cancer (5 in 100) or developing skin cancer in the Canadian population (2 in 100). These results suggest that the risk of developing cancer from total arsenic exposure would be 20-300 times lower than the overall cancer risk. While the incremental lifetime risk levels are above the Health Canada acceptable level of 1 in 100,000, the development of lung cancer from exposure to arsenic present on or released from the Giant Mine site will not be distinguishable in the Yellowknife population from other causes of cancer."* It appears that the report's conclusions are solely based on adult, child and a composite receptor and that cancer risks estimates were compared with the general NWT populations and Canadian general populations. As HC previously commented on this issue in 2005, these types of general comparison may not truly reflect site specific risks that may be associated with specific contaminants exposure. Health Canada has previously provided comments on this issue in our June 2005 letter Please clarify how the custodian is planning to evaluate and manage (if applicable) the residual health risks (if any) after the implementation of the Remedial Action Plan which is supported by the findings of the 2006 tier II risk assessment report.

(iii) Section 6.4 Uncertainties in the Risk Assessment: The report states that, "*There is uncertainty associated with the TRV's selected for this assessment. There is also uncertainty associated with the slope factor for evaluation of potential carcinogenic effects. A range of potential slope factors is discussed in Section 5.2 and a value of 1.2 (mg/(kg d))-1 was chosen for the assessment. This resulted in a risk of 1.2 in 1,000 for the Giant Mine Town site receptor (Table 6.3-7). With the use of a slope factor of 2.8 (mg/(kg d))-1 as recommended by the FCSAP program,*

the potential carcinogenic risk is calculated as 2.6 in 1,000. As seen in Table 6.3-7, this risk includes background exposure and is still well below the overall cancer risk for the Canadian population"

Based on HC's updated Arsenic Slope factor of 1.8, it appears that the potential carcinogenic risk calculation may be a little bit higher when compared to calculations based on CSF 1.2. Furthermore, a general comparison of adult, child and toddler potential carcinogenic risks based on those CSFs would also provide additional information and comparison pertaining to calculated potential carcinogenic risks among various sensitive age groups.

Based on the review of the report as well as the limited review of the Developers' Assessment Report (comments to be forwarded in a separate template provided by PWGSC), HC-AB contaminated sites division understands that the adoption of any future risk management plans, implementation of various remedial measures and administrative controls (if applicable) over various areas in the Giant Mine site are subject to further discussions among various stakeholders and approval by the review board. Furthermore, continuous care, maintenance and monitoring of various environmental matrices (soil, water, sediment and air, if applicable) would identify and manage additional human exposure and health risks issues (if any) in the future. Please clarify what criteria and exposure guidelines are being discussed for the future proposed residential, re-creational and other sensitive land uses in the area. If there is a need in the future; HC-AB can also offer assistance to custodians with regards to our expertise in the areas of public involvement processes for contaminated sites.

Thank you very much for providing Health Canada-Alberta Region an opportunity to review this report. Please call the undersigned if you have any questions or concerns.

Sincerely,

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June 6, 2005

The following presents preliminary comments of Health Canada's Environmental Health Assessment Service (EHAS), regarding the evaluation of anticipated human health risks following two proposed remediation scenarios as presented in the report titled "Giant Mine Remediation Draft Plan" dated January 2005, prepared by SRK Consulting. Comments are limited to the report titled "Tier 2 Risk Assessment Giant Mine Remediation Plan" dated December 2004, prepared by SENES Consultants Limited. Given the complexity of probabilistic modelling, and the time frame requested for comments by EHAS, the comments presented herein may be augmented at a future date following a more detailed investigation of the input parameters and model assumptions utilized in this risk assessment.

Comments are divided under the following headings:

Toxicity Reference Endpoints
Receptor Characteristics
Bioaccessibility of Arsenic in Soils
Risk Characterization, and Conclusions

Toxicity Reference Endpoints

1. Cancer Slope Factor

In Canada and the U.S. there is currently some variation in opinions of the most appropriate oral slope factor for use in assessing human health exposure risks from arsenic. The slope factors that have been employed by various regulatory and advisory agencies range from 1.2 $(mg/kg\text{-}d)^{-1}$ (Health Canada, 2005) to 3.67 $(mg/kg\text{-}d)^{-1}$(US EPA, 2001). The slope factor utilized in the current risk assessment was 1.2 ($mg/kg\text{-}d)^{-1}$, as presented by the Federal-Provincial-Territorial Committee on Drinking Water Document for Public Comment. This slope factor was derived based on internal cancers. There is some concern for EHAS with the selection of this slope factor, as it is from a draft document awaiting public comment. Currently it is uncertain as to whether or not this proposed slope factor will be adopted as being the most appropriate slope factor for use with federal contaminated site risk assessment.

Currently, published recommendations for Federal Contaminated Site Risk Assessment (Health Canada, 2004) advocates the use of an oral slope factor of 2.8 $(mg/kg\text{-}d)^{-1}$, derived based on skin cancers, and sourced from Health Canada (1996). The US EPA (2001) "National Primary Drinking Water Regulations; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring", derived a slope factor of 3.67 $(mg/kg\text{-}d)^{-1}$ based on internal cancers. This slope factor has subsequently been used by the US Consumer Product Safety Commission (CPSC, 2003) in its assessment for children's risks from arsenic in CCA-treated playsets, and by the US EPA Office of Pesticide Programs (US EPA OPP, 2004) for its evaluation of risks caused from arsenic in its Preliminary Risk Assessment for Wood Preservatives Containing Arsenic

and/or Chromium.

It should also be noted that conservatism may be warranted in the selection of an slope factor due to emerging information regarding the potential for increased susceptibility from early-life exposure to carcinogens. As the current risk assessment includes mainly residential exposures where infants and toddlers will be exposed to the contaminant in question, erring on the side of caution in the selection of a slope factor, may serve as a buffer if regulatory agencies begin to add safety factors for carcinogen exposure in the young, as the EPA has tentatively proposed in its Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens (US EPA, 2003).

Given this information, EHAS suggests, at the minimum, to present calculated risks for a range of potential slope factors, to reflect the current uncertainty in selecting an appropriate slope factor.

2. Non Cancer Toxicity Reference Value (TRV)

Carcinogenic endpoints are almost always more sensitive than non-carcinogenic endpoints. For this reason in its guidance for risk assessment for Federal Contaminated Sites, Health Canada (2004) does not include non-cancer toxicity reference values for arsenic. In Health Canada's (1996) Health-Based Tolerable Daily Intakes/Concentrations and Tumorigenic Doses/Concentrations for Priority Substances, the non cancer TDI for arsenic is also blank, and under the comment section the reader is instructed to refer to estimates for carcinogenic potential. However, there is a foot-note that indicates that the FAO/WHO had derived a provisional weekly intake for As and Cd.

As with cancer, there is currently no international agreement on the most appropriate non-carcinogenic TRV for arsenic. The FAO/WHO (1988) Expert Committee on Food Additives (JECFA) concluded that "on the basis of the data available, the Committee could arrive at only an estimate of 0.002 mg/kg-d as a provisional maximum tolerable daily intake for ingested inorganic arsenic." This number has been adopted by the Food Directorate as their *Provisional* Tolerable Daily Intake (PTDI) for foods. The current risk assessment for Giant Mine utilizes this PTDI for its assessment of non-cancer human health risks.

EHAS has some concerns with the reference dose selected for this risk assessment. These include noting that the JECFA did not include the rationale for the value of 0.002 mg/kg-d, that the Food Directorate has only adopted the TDI as a provisional value and, as mentioned in the risk assessment, other international regulatory bodies promote a substantially lower reference dose (USEPA, and ATSDR have recommended a reference dose/minimum risk level of 0.0003 mg/kg-d)

It should be noted that the WHO/FAO PTDI that was adopted by the Food Directorate of Health Canada is applied by this department to food-borne exposures only. This value is not endorsed by EHAS as being applicable to water-borne (dermal, ingestion), soil-borne (dermal, ingestion) nor particulate-borne (for inhalation) exposures. As is the recommendation for cancer slope factor, EHAS believes it would be preferable to present the risk outcomes utilizing both TRVs (*i.e.* 0.002 mg/kg-d and 0.0003 mg/kg-d). An assessment which shows no unacceptable risks using either TRV would remove the uncertainty of reference does selection from the evaluation. Conversely, an assessment which shows acceptable risks with one TRV, but

unacceptable risks with the other, would indicate that selection of the most appropriate reference value deserves special attention, including a critical review of the assumptions utilized when developing these reference doses.

Receptor Characteristics

The current risk assessment presents risks for 2 life stages, a 70 kg adult, and a 32.9 kg child. Health Canada (1994) and the CCME (1996), identify 5 life stages and corresponding characteristics, that should be utilized for human health risk assessments. These are infants (0 to 6 months of age); toddlers (7 months to 4 years of age); children (5 to 11 years); teens (12 to 19 years); and adults (20+ years of age). It is particularly relevant that the toddler be evaluated, consistent with advice and guidance proffered by Health Canada, CCME, and most provinces/territories, as they often represent the critical receptor for residential land use scenarios.

For the current risk assessment, EHAS recommends that with the exception of the marina site, all other modelled locations include representatives from each of the 5 life stages. In addition it is recommended that for the cancer assessment, cancer risk is amortized over all life stages.

Bioaccessibility of Arsenic in Soils

In the current risk assessment, a bioaccessibility factor of 17% for arsenic present in soil and sediments was used. The use of this value is of concern to EHAS. The specific concerns over the current choice of bioaccessibility factor are outlined below.

1. The use of sediment data as surrogate for soil data.

The justification for utilizing river sediments as a surrogate for typical residential yard and garden topsoil (assumed to be the primary source of material for soil ingestion) was not presented in the report. Potential differences between river sediments and topsoil which may influence bioaccessibility of arsenic may include: variation in soil characteristics such as particle size (and associated surface area to particle volume or mass), particle composition (clays versus oxides/oxyhydroxides, silicates, etc.), soil chemistry such as soil pH, cation exchange capacity, redox conditions, organic carbon content and the presence of anionic species that form complexes with metal cations such as organic acids, phosphate, chloride, carbonate, sulfides and hydroxides. As reported by Risklogic (2002), Ollson *et al.* 2001, measured potential bioaccessibility of 5 soils samples representative of residential soils in Yellowknife and measured bioaccessibility in those samples ranging from 22.9% to 73.1%. This indicates that the use of river sediments may not be a suitable surrogate for yard and garden topsoils.

2. The use of a 1:20 ratio of soil : simulated gastric fluid.

Various researchers have noted that, at least for some contaminants, bioaccessibility increases with an increasing ratio of acidic leachate to soil mass. The following is excerpted from Richardson *et al.* (2005), in an article that has been accepted for publication by the journal Human and Ecological Risk Assessment:

> Hamel *et al.* (1998) found that, for one soil type, the measured bioaccessibility of arsenic increased by a factor of approximately 5 when the ratio of simulated gastric fluid (mL) to soil (g) was increased from 100:1 to 5000:1. A variety of ratios of simulated gastric fluid to soil have been employed for bioaccessibility assays, ranging from 5:1 to 5,000:1 (reviewed by Ollson, 2004). The most common assay designs for measuring the bioaccessibility of soil-borne contaminants employ a ratio of leachate volume to soil mass of 100 mL:1 g (Kelley *et al.*, 2002, among others), but none approach the ratios likely to exist in the toddler or adult GIT; a ratio on the order of 10,000 mL:1 g soil, or greater. Although the 100:1 ratio used in in vitro studies does not approach the ratios likely to exist in the toddler or adult GIT, in vivo data correlates reasonably well, at least for lead, suggesting it is a reasonable surrogate for this element in most cases. Unfortunately, at present, it is impossible to predict when or how the use of a 100:1 ratio will not produce representative results for other elements.
>
> Adults are thought to ingest between 20 mg of soil per day (CCME, 1996) and 100 mg per day (USEPA, 1997), on average. Average soil ingestion by toddlers (assumed to be 0.6 years to 4 years of age) is higher at between 80 mg per day (CCME, 1996) and 400 mg per day (USEPA, 1997). Soil ingestion is unlikely to occur at a uniform rate throughout the day. However, it is also unlikely to be delivered as a single bolus dose, but be distributed irregularly (in both time and mass ingested) throughout waking hours (12 to 16 hours per day).
>
> The volume of gastric fluid produced in 12 hours by an adult averages about 960 ml at basal volume output but would exceed this amount when periods of stimulation (eating and digestion) are included (Lentner, 1981). Toddlers produce somewhat less gastric fluid at basal output but the total still approaches about a litre over a 12 hour period when stimulation is included (Lentner 1981). Therefore, the predicted ratio of gastric fluid (in mL) to soil (in g) in toddlers ranges from about 12,500:1 (1,000 mL of fluid to 0.08 g of soil) to 2,500:1 (1,000 mL of fluid to 0.4 g of soil). For adults, this ratio could range between 50,000:1 (1,000 mL of fluid to 0.02 g of soil) to 10,000:1 (1,000 mL of fluid to 0.1 g of soil).

2. The use of overall mean value instead of upper 95% confidence interval.

Risk Characterization, and Conclusions

2. Non-Cancer risk assessment

From Section 7.5 of the Tier 2 risk Assessment - Giant Mine Remediation Plan:
"*People living in the study area are not at risk of adverse effects from arsenic exposure even though arsenic levels in the area are higher than found in most communities. The estimated total arsenic intakes for Yellowknife area residents are below the Health Canada Toxicity Reference Value.....*"

Not including concerns presented by EHAS in the previous sections, this statement appears to be incongruous with what is presented in Section 6.3.7:

"*At the 95th percentile level, the predicted total arsenic intakes for all child receptors were above the TRV. As well, the 95th percentile arsenic intake estimate for the most exposed adult (Receptor 4a) was above the TRV in the Case 2 remediation scenario.*"

3. Carcinogenic Risk assessment

From Section 6.3.6:
"Figure 6.3-10 provides a comparison of the predicted arsenic risks for Receptor 4 to other Canadian cancer statistics. As seen in the figure, the predicted cancer risks are below the lifetime incidence cancer rate of 3 in 10 for the Northwest Territories population (Canadian Cancer Statistics) as well as being below the risks of developing lung cancer (5 in 100) or developing skin cancer in the Canadian population (2 in 100). These results suggest that the development of lung cancer from exposure to arsenic present on or released from the Giant Mine site will not be distinguishable in the Yellowknife population from other causes of cancer."

And section 6.3.5:
"*In several of these communities, none to date has reported skin cancer (or other adverse effects associated with arsenic exposure) in cross-sectional evaluation of either the entire community (Chapels Cove, Newfoundland, arsenic in drinking water) or a population sample (Wawa, Deloro, arsenic in soil). Although these cross-sectional evaluations may not constitute an accurate measure of incidence of skin cancer in these communities, they do reflect an indirect measure of incidence. These results are not unexpected since the intakes are below intakes associated with skin cancer or other types of cancer (liver and bladder) which are associated with arsenic exposure*"

The comparison of incremental lifetime cancer risk from a single source (arsenic present on or released from the Giant Mine site) to lifetime risks of an individual developing cancer in general can lead to confusion and is not considered appropriate for a contaminated site risk assessment. Comparing incremental lifetime risk to entire classes of cancers, in this case lung cancer and skin cancer, blends together voluntary actions such as smoking and sun-bathing, to

involuntary actions, such as a child living with his or her parents in a community which has been contaminated by industrial pollution.

In addition, the development and the use of a acceptable lifetime incremental risk levels (eg. 1 in 100,000) is done precisely because of the difficulty of distinguishing the development of cancer caused from a single source from the high background level of other cancers. This distinction becomes even more difficult when the exposed population is small, and therefore one would need several generations of data to be able to detect a significant pattern of cancer caused by a particular source. If a population is sufficiently small, it is possible that a significant pattern of cancer will not be able to ever be determined. Failure to definitively distinguish increases in cancer occurrence, does not in itself signify negligible or inconsequential cancer risks.

References

Canadian Council of Ministers of the Environment (CCME). 1996. A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines. Report CCME EPC-101E, CCME. March 1996.

CPSC. 2003. Briefing Package. Petition to Ban Chromated Copper Arsenate (CCA)-Treated Wood in Playground Equipment (Petition HP 01-3). February 2003.

FAO/WHO. 1988. Joint FAO/WHO Expert Committee on Food Additives Series 24
From http://www.inchem.org/documents/jecfa/jecmono/v024je08.htm.

Health Canada (Federal-Provincial-Territorial Committee on Drinking Water). 2005. Arsenic in Drinking Water. Document for Public Comment (Comment Period ended May 17, 2005)

Health Canada (Environmental Health Assessment Services, Safe Environments Programme). 2004. Federal Contaminated Site Risk Assessment In Canada Part II: Health Canada Toxicological Reference Values (TRVs)

Health Canada. 1996. Health-Based Tolerable Daily Intakes/Concentrations and Tumorigenic Doses/Concentrations for Priority Substances. Report no. 96-EHD-194. Ottawa, Ontario.

Health Canada. 1994. Human Health Risk Assessment for Priority Substances: Canadian Environmental Protection Act Assessment Report. Health Canada, Ottawa.

Risklogic Scientific Services Inc. 2002. Assessment of human health risks posed by arsenic contamination in Yellowknife, NWT. Final Report Submitted to the Yellowkinife Arsenic Soils Remediation Committee

Richardson, M., Bright, D.A., and Dodd, M. 2005. Do current standards of practice measure what is relevant to human exposure at contaminated sites? II: Oral bioaccessibility of contaminants in soil. Manuscript submitted and accepted by the journal "Human and Ecological Risk Assessment" For further information contact mark_richardson@hc-sc.gc.ca.

US EPA. 2003. Supplemental Guidance for Assessing Cancer Susceptibility from Early-Life Exposure to Carcinogens. External Review Draft. EPA/630/R-03/003.

US EPA. 2001. National Primary Drinking Water Regulation; Arsenic and Clarifications to Compliance and New Source Contaminants Monitoring; Final Rule. Federal Register. Vol. 66, No. 14. p. 6975, January 22, 2001.

US EPA OPP. 2004. Hazard Identification and Toxicology Endpoint Selection. Document ID OPP-2003-0250-0008

Health Canada Alberta Contaminated Sites Division Submission
Re: Cursory EA Review of Developer's Assessment Report (DAR)

Date: February 26 2010

EA Review Questions for Giant Mine Remediation Project Developer's Assessment Report (DAR)

In order to recommend that the DAR is complete, reviewers may need additional information to clarify project activities and impacts relative to the reviewer's area of expertise.

Questions should focus on the completeness of the DAR with respect to demonstrating an adequate understanding of the project, the surrounding environment, potential effects, mitigation or management and the provision of information as to how plans will be carried out.

Include a preamble to the question including the section, page number and figure, table and paragraph as appropriate. As example:

1. Section 5.4.3.2.1, Figure 5.3, Page 5-2. The DAR states, "Impacts to wildlife as a result of this project are expected to be…etc".

a) Explain…..
b) Provide….
c) Clarify…

Question/Comment **Section, Figure, Table, Page.**	**Reviewer**	**TOR #** (if applicable)	**Is Additional Fieldwork Required?**	**DAR Completeness Issue?** (I.e. is the information required to resolve major information gaps or uncertainties?)
1. Section Questions/Comments **Please see below Health Canada Alberta comments and clarification questions. Please forward a finalized version of the report for our records.**				
2. Section Questions/Comments				
3. Section Questions/Comments				
4. Section Questions/Comments				
5. Section Questions/Comments				
6. Section Questions/Comments				

Based on the above template, Health Canada (Alberta) provides the following comments from a Contaminated Sites assessment perspective highlighting several key sections from the report. Please note, based on specific requests from custodians, Health Canada Environmental Assessment group generally conducts a review of the EA report and provides specific comments.

The page numbers highlighted below are based on the page numbers in the electronic copy (Acrobat PDF reader) of the report.
Total page numbers of the Developer Assessment Review (DAR) main report is 420 pages.

1. Section 1.2.9 Post Remediation Activities (Page 23 of 420)
The DAR report states that, "*Human Health Risk Assessment calculations indicate that Arsenic intakes in humans will remain within the range of estimated for other Canadians, and that there will be little risk of adverse health effects. There may however, need to be some restrictions on future activities at the site until monitoring program can demonstrate that Arsenic levels are within safe level*".

Please clarify whether there will be restrictions on land uses in proposed residential and parkland areas to protect human receptors from potential arsenic exposure via ingestion, inhalation and/or dermal pathways. On a related note, **please clarify** whether arsenic impacted areas that are co-contaminated with petroleum hydrocarbons (PHCs) will be managed accordingly to prevent preferential vapor migration (if any) towards any enclosed space, structures and/or buildings. Based on the information on PHC impacted areas provided elsewhere in the report, delineation of the extent of the PHC impacts in sub-surface is contingent on future excavation in those areas.

2. Section 2.3.3 – Soil Remediation Standard (Page 41 of 420)
The DAR report states that, "C*oncerns were voiced during the scoping exercises that the industrial soil remediation standards selected (340 mg/kg arsenic) by CARD might preclude the full use of the site for residential and recreational purposes. The Review Board decided against including this issue in the scope of the assessment. It noted in its Reasons for Decision that the soil quality standards selected by CARD as a remediation end-point would in itself not have an adverse environmental impact on the environment; it further noted that the overall soil quality of the site will be improved. The Review Board also observed that it was the land owner's responsibility to identify an acceptable remediation standard."*

Please clarify, whether criteria for other proposed land uses will be evaluated in the future by various land owners**. It is not clear** what are the mechanisms (if any) in place to notify future land owners about the potential restrictions for future and proposed land uses (e.g., residential, parkland and recreational). Please see below (point **3 and 4**) related comments regarding land uses under a post remediation scenario. The industrial soil remediation standards may not be directly applicable to proposed residential areas without any risk management and remedial measures for the proposed residential and recreational areas.

3. Section 5.10 Contaminated Surficial Materials (Page 107-108/420)
The report states that *"the contaminated materials found on the surface of the site generally consist of: "Contaminated soil" – Natural soil deposits or fill, other than waste rock or tailings, with arsenic and/or hydrocarbon contamination. In accordance with the objective set out in Section 6.1.2, only material that is above the industrial land use remediation criterion (GNWT, 2003) is included in the "contaminated soil" category herein."*

Please clarify, whether these guidelines would be used in other areas of Giant Mine Site where future land use has been proposed for residential and/or recreational. Please provide additional information on what guidelines would be used for the proposed residential and recreational areas in the surrounding Giant

Mine area.

4. (Section 6.0 Remediation Project Description and Post Remediation Land Use (section 6.1.2)
Page 117-119 of 420
Section 6.10 – Contaminated surface materials

Please clarify what criteria will be used for Giant Mine site areas that are proposed for future development. Health Canada understands that industrial land use criteria for Arsenic will be used for industrial lands Therefore, future risk management measures may include administrative control and protection of Arsenic exposure from surface and sub-surface areas where other sensitive land uses have been proposed.

5. Table 7.1.4 (**Page 186 of 420)** highlights measured Arsenic Level in Water (1973-2004).
Please provide (if available) if there more current measurements and records of Arsenic data from Water and discharges.

6. (Section 7.2.2 - Groundwater quality) Page 193 of 420
Groundwater flow is towards Great Slave Lake. The report states that "*there are no regulatory criteria covering groundwater chemistry in NWT or the rest of Canada. Therefore all groundwater data collected to date has been assessed, but it is not possible to report on the chemical quality with respect to criteria performance targets*."

Please clarify how the custodian is planning to maintain groundwater quality and resources for the region. Health Canada has published a memo related to Groundwater Aquifer use. Please find attached Health Canada's memo for your review and applications (if applicable for the site). This memo is also published on IDEA website so that custodians can use them accordingly for their sites, if applicable.

7. Section 7.3.1.2 Quality of Surface Soils; 7.3.2 – Permafrost and Ground Temperature)
Page 196 of 420

In the above sections, the DAR report states the followings:

"Yellowknife *(and the Giant Mine) is in the discontinuous permafrost zone, at the transition where this zone is subdivided into widespread permafrost (underlies 50 to 90 % of the land area) and sporadic permafrost (underlies 10 to 50 % of the land area) (Wolfe, 1998). Permafrost in the Yellowknife area postdates the withdrawal of Glacial Lake McConnell and has undergone a complex history of growth and decay during climatic fluctuations in the last 4,000 years (Aspler, 1987). Permafrost occurrence in Yellowknife is highly variable. It dominates in areas where organic material accumulates such as in peat bogs, it is widespread where silts and clays dominate, is sporadic to absent in sands and gravels, and absent near bedrock exposures that act as a heat source*"

Further, the report states:
"*It is clear that the permafrost at Giant Mine is warm, since the ground temperature remains near 0°C even where permafrost is present. It is also apparent that the permafrost recedes when the surface conditions are disturbed. In the minutes of a meeting held in December 1995, the Mine Captain noted that in the regular inspections he conducted since 1986, ice was never observed in any of the arsenic disposal stopes or chambers (Noel et al., 2003). A subsurface investigation (Geocon, 1981) penetrated selected underground chambers and stopes to assess the possibility of extracting arsenic dust for resale. The study reported*

encountering a permafrost zone above three of the chambers. In 2006, when work was conducted on Reach 4 of Baker Creek, significant permafrost and ground ice was observed in areas to the east of the AR1 arsenic storage chambers."

Furthermore, the report highlights the temperature spread in the area;
"Temperature data from all instrumented holes within and around the arsenic chambers, from the period 1996 to 2005, from ground surface to 122 m depth, range from -1.3°C (in B208) to +4.9°C (in B214), with most of the values located between -0.5°C and +3°C. The range narrows to 0°C to +2°C at a depth of 75 m to 122 m (SRK, 2006)."

"*Ground temperature measurements show that the mining activities have significantly disturbed the thermal regime that existed at the site. The disturbance is likely a combination of underground activities that introduced heat, and changes to the ground surface that removed insulating layers of overburden and increased the surface area of exposed bedrock that acts as a heat source."*

Please clarify, whether the consultant has evaluated the future potential implications of significant permafrost melting and permafrost loss and influence on the fate and transport of residual volatile contaminants (e.g., PHC and related contaminants outside of the permanently frozen areas) that will remain in the sub surface areas.

Please provide additional information pertaining to risk management measures (if any) proposed for those areas where residential and other sensitive land uses have been proposed.

Please clarify whether additional site investigation is planned to delineate the contaminated areas as some of the areas will be excavated and conditions will be assessed later (specifically, the areas with potential residual PHC impacts in sub surface areas).

What are the potential human health impacts associated with various remedial methods proposed to address various components of the remediation project. For example, in the event of operational and technical issues (if any), what are the contingency measures proposed to manage immediate and long term impacts (if any) to the human health and the communities nearby? What are the triggers and action thresholds proposed for various environmental components (e.g., air, soil, water, sediments) for the site and the surrounding areas to trigger a response for further action to manager potential human health risks (if any). A similar comment related to long term monitoring and adaptive management strategy is provided below.

8. Section 7.4.2 Ambient Air Quality (page 203 of 420)
In light of decisions to use diesel fired engines for active thermosyphons for initial heating purposes; **please clarify**, whether there will be additional monitoring of air contaminants in and around the mine site to evaluate exposure conditions during the process of active freezing.

9. Section 8.9 Assessment of Ecological and Human Health Risks & 8.9.1 – Overview: (Page 317 of 420)

The overview section states that….."the Project is not anticipated to result in "*significant residual adverse effects*" to any environmental components"

Please provide some additional information and clarify on the assessment of the extent of "significant residual adverse effects" that will remain in and around Giant Mine site based on the proposed remediation plan as a result of the application of industrial Arsenic standard (360 mg/kg) and other thresholds and triggers

that might be used for various areas and for various environmental components (i.e., soil, sediments, air, surface water and groundwater, etc.). Health Canada understands that at this time, some of the triggers and thresholds have not been established as discussions may be ongoing and it would be contingent upon discussions with multi-stakeholder advisory groups during and after the review of this DAR report by the review board.

The DAR report also states that, *"in fact, the method requires a number of inputs and assumptions, some of which are well established and some of which are less well understood"*

Health Canada would like to take this opportunity to emphasize that (as stated in the June 06, 2005 Health Canada comment letter forwarded to INAC), "As the current risk assessment includes mainly residential exposures where infants and toddlers will be exposed to the contaminant in question, erring on the side of caution in the selection of a slope factor, may serve as a buffer if regulatory agencies begin to add safety factors for carcinogen exposure…….".

For additional comments related to health risks issues, please refer to our email transmittal letters dated June 06, 2005 and February 19, 2010. The Risk Assessments conducted in 2004 and finalized in 2006 is based on various assumptions on a spatio-temporal scale considering the complexity and large scale nature of the Giant Mine Remediation project Health Canada understands from the prior advisory board report and recommendations that if those assumptions do not remain valid in coming years, then the conclusions and recommendations associated with the remediation project may have to be re-evaluated at a later time. **Please clarify** how the custodian is planning to address this issue.

On a related note, the health risk assessment may need to be updated (if required) based on site specific updated data (if any) from soil, air, water and sediments and refinements in the risk assessment process, if applicable. **Please provide** additional information on this.

Several sections of the DAR report remains incomplete. **Please provide** a final document upon completion of those sections. Based on the TOR concordance table and various sections of the DAR report, it seems that "Traditional Knowledge" Component have not been incorporated in various sections as community consultations may be ongoing or being planned later over the coming years. **Please clarify**

Please note If requested, Health Canada Risk Communication and Public Involvement (RCPI) group can provide assistance in the areas of the public involvement processes for contaminated sites in the future.

10. Section 13 – **Proposed Long-Term Monitoring and Adaptive Management Strategy** is not complete as the concordance table and the DAR report states that *"input/discussions with client"* required. Section 13.1 (Monitoring Framework) states that *"Monitoring will be conducted in accordance with a comprehensive monitoring plan that has received input from all relevant stakeholders."*

Please clarify and please provide information (when available) related to various **monitoring triggers and thresholds for actions** under long term monitoring and adaptive management strategies proposed for implementation at the site.

Section 13.1 (Adaptive management) also states that, "While a formal process will be established to consider this feedback, pre-defined actions will not be developed. Instead, the Project proponent will identify and implement the most appropriate course of action to respond to the findings of the monitoring program"

Please clarify how the proponent is planning to address (a) accidental exposure to contaminant in excess of applicable criteria; and (b) to control potential exposure; and (c) to manage and reduce risks from overall exposure from soil, sediment, water, and air.

Thank you very much for providing an opportunity to Health Canada (Alberta Region). Please contact the undersigned if you have any questions or concerns.

Sincerely,

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